BEFORE
THE PUBLIC SERVICE COMMISSION OF
SOUTH CAROLINA

DOCKET NOS. 2021-88-E

South Carolina Energy Freedom Act (H.3659) Proceeding to Establish Dominion Energy South Carolina, Inc.'s Standard Offer Avoided Cost Methodologies, Form Contract Power Purchase Agreements, Commitment to Sell Forms, and Any Other Terms or Conditions Necessary (Includes Small Power Producers as Defined in 16 United States Code 796, as Amended) – S.C. Code Ann. Section 58-41-20(A)	Docket No. 2021-88-E

DIRECT TESTIMONY OF ED BURGESS

ON BEHALF OF

THE CAROLINAS CLEAN ENERGY BUSINESS ASSOCIATION

July 27, 2021

DESC Avoided Cost Testimony of Ed Burgess

1. Summary of Findings and Recommendations

Key Findings

Q. What is the purpose of your testimony?

A. My testimony reviews DESC's proposed Variable Integration Cost (VIC) charge and mitigation protocol. I explain why the analysis supporting the VIC is fundamentally flawed and make recommendations for how integration costs attributed to solar QFs should be treated going forward.

Q. Can you please provide a summary of your key findings?

A. My key findings are summarized below.

- DESC's proposed 88% increase in the VIC for existing Tranche 1 facilities and 257% increase for Tranche 2 facilities is based on hypothetical and inflated integration costs rather than actual or realistic costs. The proposal is thus inconsistent with Order No. 2020-244.
- Historical levels of operating reserves maintained by DESC have far exceeded the levels of reserves DESC assumes are required to integrate solar Tranches 1, 2, and 3. Thus incremental integration costs in the recent past and near future are likely close to zero.
- DESC's 2021 VIC analysis suffers from many of the same deficiencies identified in the 2019 proceeding and introduces new errors. Correcting for just three of these deficiencies results in a 26-71% decrease in the VIC from the present interim level, rather than the proposed 88-257% increase. Correcting other errors would reduce the VIC even further.
- As in 2019, DESC continues to avoid using a transparent methodology informed by stakeholder feedback for determining its integration costs.
- DESC's mitigation protocol is highly flawed and appears designed to ensure the maximum VIC is charged rather than encourage behavior that would actually mitigate DESC's integration costs.

Recommendations

Q. Can you please provide a summary of your recommendations to the Commission?

A. Yes. My recommendations to the Commission are summarized below.

- The Commission should reject DESC's proposal to increase the VIC for facilities in both Tranche 1 and Tranche 2 (and above) since such an increase is unsupported by the evidence DESC presented.
- A final fixed VIC should be adopted in this proceeding. Any changes to the VIC in subsequent proceedings should not apply to PPAs subject to the final fixed VIC adopted in this proceeding.
- Given the lack of incremental operating reserve needs beyond historical levels, a VIC charge of $0/MWh is appropriate. This is consistent with the lack of any observed reserve shortfall in DESC's analysis of Tranche 1 (without reserves) when certain errors are corrected.
- If the Commission feels compelled to adopt a non-zero VIC in this proceeding, the Commission should consider values of $0.28/MWh or less for Tranche 1 and $0.71/MWh or less for Tranche 2 (and above), which correct for some of the deficiencies in DESC's VIC analysis.[1] Establishing a final fixed VIC at these levels is more reasonable than what DESC has proposed and would provide cost transparency and certainty to QF developers, even if these values do not address all of the deficiencies in DESC's analysis.
- Any future integration cost studies – including studies for what DESC calls "Tranche 3" -- should follow the stakeholder process outlined in South Carolina statute, Section 58-37-60(A).
- The mitigation protocol proposed by DESC should be rejected and the Commission should require DESC to adopt a protocol more similar to the one Dominion developed for North

[1] DESC's initial application and testimony did not include a complete set of workpapers with the underlying data necessary for me to evaluate all aspects of the company's VIC proposal. Through discovery, CCEBA has been able to obtain many of these workpapers and data sets, but not all of them necessary to conduct a complete review. Depending on my review of this additional information, my recommended level for the VIC may be revised.

Carolina. This protocol should also be updated to include key improvements I describe in my testimony.

Q. Do you have any Exhibits to introduce through your testimony?

A. Yes. In my testimony I introduce the following Exhibits:

Exhibit A: Resume

Exhibit B: Dominion Energy North Carolina Mitigation Protocol

2. Introduction

Q. Please state your name, title, and business address.

A. My name is Ed Burgess. I am a Senior Director at Strategen Consulting. My business address is 2150 Allston Way, Suite 400, Berkeley, California 94704.

Q. Please summarize your professional and educational background.

A. I am a leader on Strategen's consulting team and oversee much of the firm's utility-focused practice for governmental clients, non-governmental organizations, and trade associations. Strategen's team is globally recognized for its expertise in the electric power sector on issues relating to resource planning, transmission planning, renewable energy, energy storage, utility rate design and program design, and utility business models and strategy. During my time at Strategen, I have managed or supported projects for numerous client engagements related to these issues. Before joining Strategen in 2015, I worked as an independent consultant in Arizona and regularly appeared before the Arizona Corporation Commission. I also worked for Arizona State University where I helped launch their Utility of the Future initiative as well as the Energy Policy Innovation Council. I have a Professional Science Master's degree in Solar Energy Engineering and Commercialization from Arizona State University as well as a Master of Science in Sustainability, also from Arizona State. I also have a Bachelor of Arts degree in Chemistry from Princeton University. A full resume is attached as Exhibit A.

Q. On whose behalf are you testifying?

A. I am testifying on behalf of the Carolinas Clean Energy Business Association (CCEBA).

Q. Have you ever testified before this Commission?

A. Yes. I testified in the evidentiary hearings for the 2019 Avoided Cost cases for Dominion Energy South Carolina (DESC), Duke Energy Carolinas, and Duke Energy Progress (Docket Numbers 2019-186-E, 2019-185-E, and 2019-184-E).

Q. Have you ever testified before any other state regulatory body?

A. Yes. I have testified before the Massachusetts Department of Public Utilities on behalf of the Massachusetts Attorney General's Office ("AGO") at the evidentiary hearings for D.P.U. 18-150 and D.P.U. 17-140. I have also supported the AGO as a technical consultant in other cases including D.P.U. 17-05, D.P.U. 17-13, D.P.U. 15-155, and D.P.U. 17-146. I have also testified before the Oregon Public Utilities Commission in Docket Numbers UE 375 and UE 390 pertaining to PacifiCorp's Transition Adjustment Mechanism. I provided written testimony to the Indiana Utility Regulatory Commission on behalf of the Citizens Action Coalition and Earthjustice on coal fuel costs in two proceedings related to Duke Energy's Fuel Adjustment Clause (IURC Cause No. 38707 FAC 123 S1 and FAC 125). I also recently provided testimony to the Nevada PUC on NV Energy's Integrated Resource Plan in (Docket No 20-07023). I have testified before the California Public Utilities Commission on behalf of Sierra Club in PacifiCorp's 2020 and 2021 Energy Cost Adjustment Clause proceedings (A.19-08-002 and A.20-08-002). Additionally, I have represented numerous clients by drafting written testimony, drafting written comments, presenting oral comments and participating in technical workshops on a wide range of proceedings at Public Utilities Commissions in Arizona, California, District of Columbia, Maryland, Minnesota, Nevada, New Hampshire, New York, North Carolina (including technical analysis for the Attorney General's Office on Duke Energy's 2020 IRP), Ohio, Oregon, Pennsylvania, at the Federal Energy Regulatory Commission, and at the California Independent System Operator.

Q. How is your testimony organized?

A. My testimony is organized into the following sections:

(1) Section 1 provides a summary of my findings and recommendations,

(2) Section 2 is this introduction,

(3) Section 3 is a brief summary of DESC's proposed increase in the VIC,

(4) Section 4 addresses key assumptions for operating reserves used in DESC's VIC analysis and how these differ from DESC's normal operating practices,

(5) Section 5 presents additional analysis on DESC's historical level of operating reserves,

(6) Section 6 discusses a variety of deficiencies in DESC's analytical approach and how these compare to its approach in 2019,

(7) Section 7 discusses how an integration study like DESC's could be improved through a transparent stakeholder process,

(8) Section 8 provides recommendations on a more appropriate VIC charge than what DESC has proposed,

(9) Section 9 discusses DESC's proposed mitigation protocol.

3. Overview of DESC's Proposed VIC & Mitigation Protocol

Q. What is the purpose of the Variable Integration Cost ("VIC") Charge that DESC proposes to apply to certain solar QFs?

A. The purpose is to recover incremental operating costs DESC supposedly incurs and will incur to accommodate the variability of solar generators' output. DESC explains that these incremental costs arise from the need to carry additional operating reserves as the level of solar penetration increases. If operating reserve requirements increase (all else being equal) then the system operator, which is DESC in this case, will likely need to redispatch generation resources accordingly. This can lead to a slight increase in overall operating costs relative to a scenario where the additional reserves were not needed.

Q. Is DESC proposing to apply the VIC equally to all PPA contracts with solar QFs?

A. No. An initial "Baseline" quantity of solar PPAs (0-340 MW of installed capacity) were previously executed without any VIC-related provisions. These facilities would continue to have no VIC charge applied. Meanwhile, DESC proposes that a VIC of $1.80/MWh be applied to existing solar PPA contracts that contain VIC clauses. This group is referred to as "Tranche 1" and includes facilities installed above the 340 MW Baseline up to 973 MW of cumulative installed

capacity. Tranche 1 facilities are currently subject to an interim VIC charge of $0.96/MWh, so DESC's proposal reflects an 88% increase, which would also apply retroactively to existing facilities. Finally, for new capacity installed in "Tranche 2," which refers to any installed capacity above 974 MW (cumulative), the proposed VIC would be $3.43/MWh. The table below provides a summary of the proposed changes.

Cumulative Installed Capacity	**Current VIC**	**Proposed VIC**
0-340 MW (Baseline)	None	None
341-973 MW (Tranche 1)	$0.96/MWh	$1.80/MWh
974 MW and above (Tranche 2)	$0.96/MWh (no known contracts to date)	$3.43/MWh

4. <u>DESC's proposed 88% increase in the VIC for existing Tranche 1 facilities is based on hypothetical and inflated integration costs rather than actual or realistic costs.</u>

Q. What is the basis for DESC's proposed VIC for Tranche 1?

A. DESC's proposed increase in the VIC for existing facilities, from $0.96/MWh to $1.80/MWh, is solely based on the results of a simulation model conducted by Guidehouse. It is worth noting that Guidehouse's model is only a hypothetical projection of the potential integration costs that DESC might incur. While Guidehouse has taken steps to make sure its model is accurate, no model is a perfect representation of reality and the Guidehouse results should be viewed as a rough approximation of possible operating conditions on the DESC system. Additionally, I believe that some of the model inputs – particularly the incremental operating reserve requirements – grossly misrepresent DESC's actual operating practices in a way that significantly inflates the modeled integration costs.

Q. Has Guidehouse testified as to what DESC's actual integration costs have been over the last several years as Tranche 1 facilities have been installed?

A. No. As mentioned above, Guidehouse's VIC analysis is based on a modeled simulation and is not a representation of actual integration costs incurred by DESC in recent years as solar QFs have come online. As of this filing about 863 MW, or nearly all (~90%) of the Tranche 1 facilities, have already come online and DESC already has considerable experience operating its system with these resources.

Q. Did DESC's initial application, amended application, or direct testimony in this proceeding present any evidence of what its actual operating reserves or related integration costs have been in recent years?

A. No. While DESC discusses at a high level some of the operational issues it has encountered as more solar has come online, it did not provide any data on actual costs associated with addressing these issues to date.

Q. Did the Commission allow for potential adjustments to the present interim VIC Charge of $0.96/MWh that is currently being applied to Tranche 1 facilities?

A. Yes. In Order No. 2020-244, the Commission stated the following:

> "The Commission finds SBA witness Burgess's testimony compelling and adopts his recommended VIC/EIC of $0.96/MWh as it more accurately adjusts the modeling done by the Company and provides a rate that more closely reflects the actual cost of integration. The Commission emphasizes that this is a temporary, interim value until a more accurate cost can be determined through an integration study. Once a more accurate rate is determined, the VIC/EIC will be subject to a true-up, either up or down, depending on the actual integration cost indicated by the integration study."[2] (emphasis added)

Thus, in its March 2020 Order, the Commission contemplated a future true-up of the VIC charge applied to Tranche 1 facilities. However, it is readily apparent from the excerpt above that the Commission was intending for this true-up to be based on "the actual integration cost" rather than continued reliance on a simulation model.

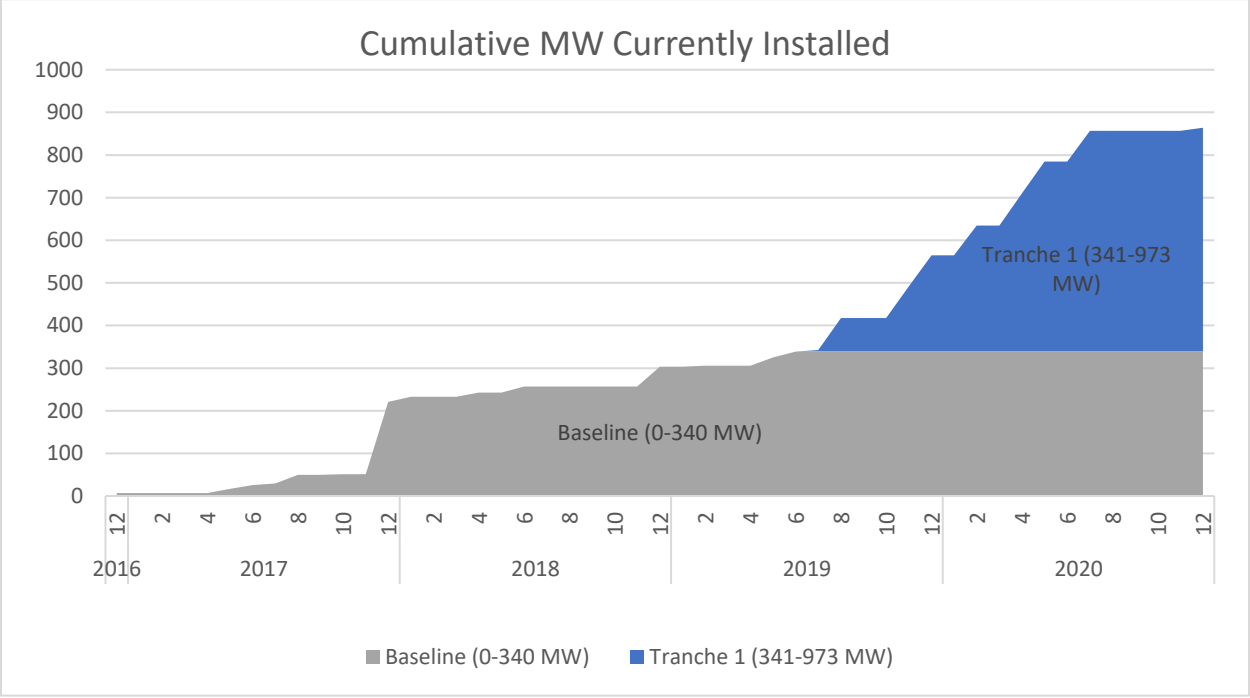
[2] Order No. 2020-244, p 5-6.

Q. Is DESC's proposed adjustment to the current Tranche 1 VIC charge reflective of "the actual integration cost" as per the Commission's Order?

A. No. As I stated earlier DESC's VIC proposal is based on an approximation of possible integration costs projected using a simulation model. Meanwhile, the model appears to use grossly inaccurate input assumptions that do not reflect DESC's actual operating practices.

Q. Has DESC had sufficient opportunity to evaluate the impact of the majority of Tranche 1 facilities on actual integration costs?

A. Yes. DESC has had over 2 years to collect data on integration costs incurred due to solar above the Baseline level of 340 MW. The chart below illustrates the timing of when solar facilities in Tranche 1 have come online. Some of these facilities were installed as early as July 2019. Thus, DESC should have been able to track the corresponding increase in Operating Reserves and corresponding integration costs over this time period.



Q. How would DESC be able to track these increased operating reserves and corresponding integration costs?

A. System operators typically conduct a forecast on a regular basis (e.g., daily) to determine their near-term generation needs, including operating reserves, for each hour of the next day, or next several days. DESC confirmed that it uses a similar approach in response to ORS Request 3-3, stating that its system operators "maintain Operating Reserves for the current day and next several days and adjust the unit commitment to maintain Operating Reserves as needed in real time." DESC's response went on to explain that a discrete component of its total operating reserves is related to solar. Specifically, DESC stated that "[a]dditional operating reserves in the amount of 40% of the hourly solar forecast or 40% of actual solar generation are held as part of Operating Reserves during solar hours." Thus, I would have expected that DESC's application in this case to describe the actual amount of operating reserves it held during each forecast over the last few years and see how both the total reserves and solar component have changed over time as more solar was added to DESC's system. This historical data could then be used to more accurately calibrate the operating reserves requirements associated with Tranche 1 facilities in a model like the one used by Guidehouse (i.e., PROMOD). Alternatively, DESC may be able to use its historical forecasts to directly estimate any incremental costs incurred by holding certain resources as operating reserves.

Q. Were you able to obtain any historical records of DESC's operating reserves from recent years?

A. Yes. In response to CCEBA Interrogatory 1-4, DESC provided data on operating reserves held on its system over the last 5 years, with a 1-minute resolution. Note that this information was provided several weeks after DESC's direct testimony and several months after its initial application in this case. I provide additional analysis on these historical reserves in the next section.

Q. Did Guidehouse rely on any historical data to calibrate the level of solar-related operating reserves or corresponding integration costs?

A. Based on my review, I would say they did not

Q. What is your reaction to that?

A. It is concerning to me because the operating reserves DESC's system operators have deployed (or are likely to deploy) to accommodate solar in the real world appear to be significantly lower than what Guidehouse has modeled for its VIC analysis. As such, I believe the Guidehouse analysis has significantly overestimated the integration costs included in the VIC.

Q. Do you have any evidence or analysis to support your conclusion that DESC is overestimating the operating reserve requirement in its VIC analysis?

A. Yes. The chart below provides an illustrative example of how DESC's VIC analysis includes extremely inflated estimates of incremental operating reserve requirements for solar. On this chart, the yellow dotted line is a plot of estimated hourly solar generation from Tranche 1 facilities for a day in April 2022. The data used to generate this plot were taken directly from DESC's VIC workpapers and reflects the exact amount of Tranche 1 solar production included in Guidehouse's model for this day. Meanwhile, the orange line reflects the corresponding amount of operating reserves DESC's system operators would be likely to hold to accommodate Tranche 1 solar. As explained above, the standard practice of DESC's system operators is to hold "operating reserves in the amount of 40% of the hourly solar forecast or 40% of actual solar generation" in order to account for solar variability. The orange line in the chart represents 40% of the modeled solar generation. Finally, the blue line represents the incremental operating reserves assumed by Guidehouse to model integration costs. As noted in Exh. PBD-2 Table 9, the incremental operating reserves for Tranche 1 were assumed to be 382 MW for the month of April.[3] What is readily apparent from this chart is the stark difference between the orange and blue lines, revealing how much higher the operating reserves are in the Guidehouse analysis when compared to what is more realistic based on DESC's actual operating practices. In fact, for this particular day, the excess in modeled operating reserves ranges from 89% higher to 4,041% higher than what is realistic based on DESC's actual operating practices.

[3] While the modeled reserves assumed in PROMOD were held constant for all hours of the month, the non-solar hours have been reduced to zero in this chart, consistent with DESC's approach which excludes non-solar hours from the VIC calculation.

While this represents an illustrative example for a single day, this pattern exists for every day in DESC's analysis.

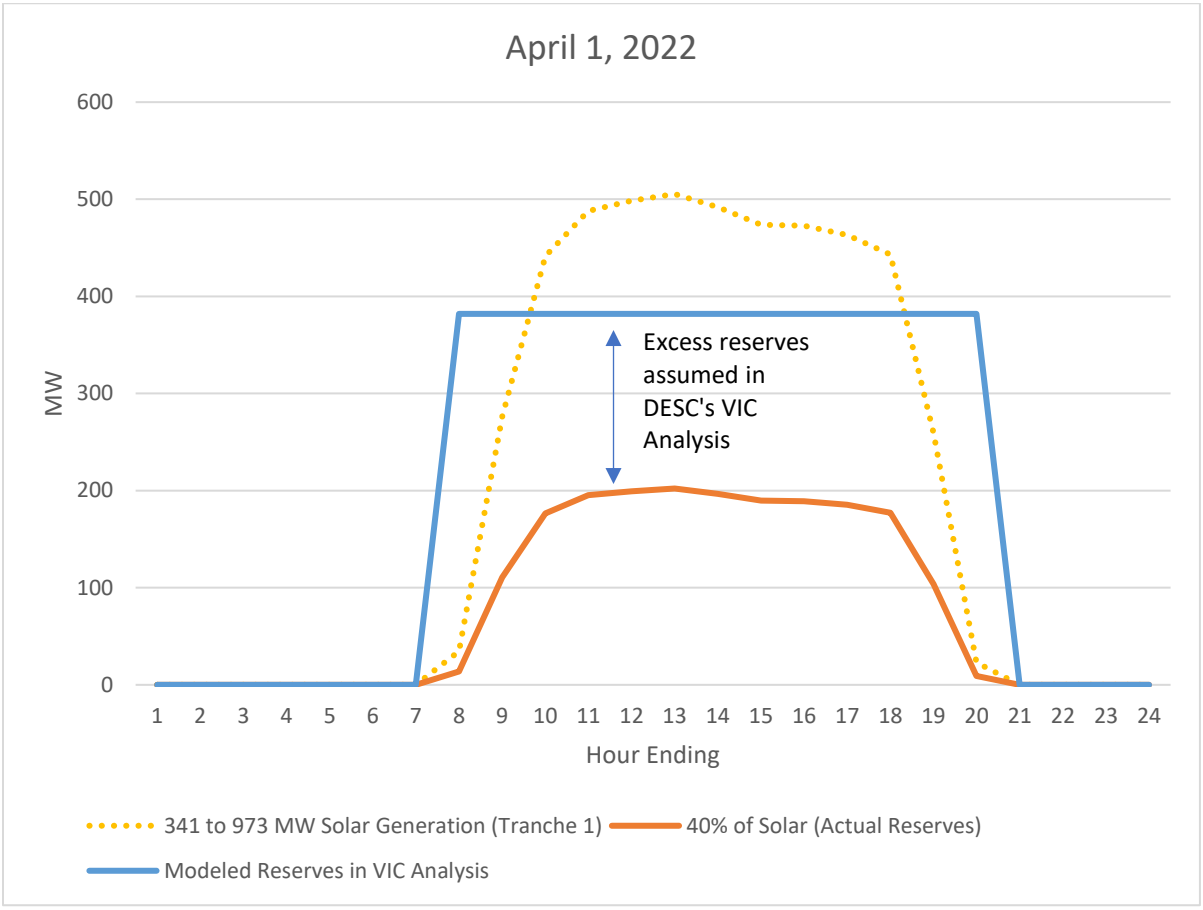


Figure 1. Comparison of modeled incremental Operating Reserves assumed in DESC's VIC Analysis to the incremental reserves that would be held according to DESC's operating practices.

Q. Do you believe DESC's current practice of holding incremental operating reserves equal to 40% of the expected solar generation is appropriate?

A. It is difficult to evaluate without more information. The fact that DESC's system operators hold incremental operating reserves equal to 40% of expected solar output was revealed through a response to discovery provided to CCEBA. DESC's application and testimony did not provide any further explanation or support for this practice. Thus it is possible that the 40% level is

appropriate. It is also possible that the 40% level is still higher than truly necessary based on industry best practices. In either case, the 40% level of reserves is still much less extreme than the excessive level of reserves assumed in Guidehouse's VIC analysis.

Q. What is your recommendation then based on these findings?

A. As explained above, the Guidehouse analysis assumes grossly inflated operating reserve requirements that do not match DESC's actual operating practices. These flawed assumptions in turn lead to a grossly inflated and incorrect VIC charge calculation. As such, the Guidehouse analysis and resulting VIC charge cannot be viewed as a credible representation of any integration costs DESC is likely to incur. Accordingly, I recommend that any increase in the VIC for Tranche 1 should be rejected and instead my analysis (presented in Section 8 below) should be adopted. While there are many reasons for rejecting DESC's proposal, chief among them is the fact that DESC did not present historical data demonstrating that the total operating reserves it has deployed in recent years have increased due to solar (let alone that any such increases were necessary and consistent with industry best practices). Furthermore, DESC did not demonstrate that the operating reserve assumptions used in Guidehouse's VIC Tranche 1 analysis are in any way reflective of the way DESC operates its system to accommodate solar. Finally, for future Tranche 2 (and above) facilities, I believe that any VIC charge exceeding the levels I have recommended in Section 8 may also be premature until DESC has completed a historical analysis of actual integration costs consistent with Order No. 2020-244.

5. Analysis of DESC's historical operating reserves suggest that the incremental costs for integrating solar Tranches 1, 2, and 3 may be zero or close to zero.

Q. You mentioned that DESC recently provided some data on its historical operating reserves. Correct?

A. Yes. Although DESC did not provide this information with its application or testimony, its responses to CCEBA's discovery included additional information, approximately one week before the extended filing deadline for intervenors.[4]

[4] DESC response to CCEBA Interrogatory 1-4

Q. Have you had a chance to analyze this information?

A. I have conducted a preliminary review. However, the dataset DESC provided contains millions of data points, so my analysis is ongoing. I should be able to provide additional testimony related to that information in surrebuttal testimony.

Q. Based on your review thus far, what have you learned about DESC's operating practices in recent years?

A. I have learned several key facts relevant to DESC's VIC proposal.

First, the amount of total operating reserves DESC's system operators typically deploy does not appear to have appreciably increased even as DESC has integrated ~90% of the Tranche 1 solar facilities (~863 MW). For example, during the July 2016 to July 2017 period – when virtually no solar QFs were deployed – the average level of Generation Contingency Reserves DESC held on its system was 1,045 MW. This level increased to 1,053 MW (a <1% increase) during the more recent July 2020 to June 2021 period, when ~90% of Tranche 1 was deployed. This is in stark contrast to DESC's VIC analysis which suggests that integrating Tranche 1 will require a >100% increase in operating reserves for most months as suggested in Exh. PBD-2, Table 11. While a portion of the total reserves held on DESC's system in recent years have been recategorized as solar reserves (instead of generic generation contingency), the overall amount of reserves being deployed appears basically unchanged.

Second, the typical amount of operating reserves DESC has historically carried on its system – even prior to any recent QF installations – far exceeds what DESC claims is necessary to integrate solar Tranches 1, 2, and 3 (i.e., 1,373 MW of total solar deployed).[5] This is illustrated in the table below, which compares the historical level of operating reserves available on DESC's system (columns 2 and 3), to the assumed level of reserves needed to integrate solar Tranches 1, 2, and 3 (column 4). For every single month, the amount of reserves shown in columns 2 and 3 is far greater than those in column 4. This suggests that during most hours, no reserves need to be added to

[5] DESC VIC analysis divides solar installations into four groupings: Baseline, Tranche 1, Tranche 2, and Tranche 3. Integration costs are studied for each of the three tranches. However, in DESC's application a VIC charge is only proposed for Tranche 1, and Tranche 2.

DESC's system to accommodate solar other than what it typically carries. As such, I would expect the incremental integration cost to be essentially zero most of the time.

Table 1. Comparison of historical operating reserves to those assumed in DESC's VIC analysis. Values in columns 2 and 3 were derived from data provided by DESC in response to response to CCEBA Interrogatory 1-4. Values in column 4 correspond to Exh. PBD-2 Table 11.

[1]	**[2]**	**[3]**	[4]
Month	**Jul 2016 – Jun 2017, Avg. Historical Reserves Available (0% of Tranche 1 deployed)**	**Jul 2020 – Jun 2021, Avg. Historical Reserves Available (~90% of Tranche 1 deployed)**	**DESC VIC Analysis, Required Reserves (100% of Tranches 1, 2 & 3 deployed)**
Jul	1064	1098	794
Aug	1019	1216	774
Sep	1016	1023	798
Oct	990	956	784
Nov	1044	915	737
Dec	1124	1102	653
Jan	1129	1114	744
Feb	1091	1067	834
Mar	1017	947	889
Apr	904	1051	895
May	1030	1126	884
Jun	1111	1011	827

Q. Can you explain why the assumptions in DESC's VIC analysis appear so different than the historical data?

A. Yes. There are several reasons for this discussed later in my testimony, but one possible factor is that DESC's VIC analysis could be assuming that only 250 MW of operating reserves are included in the Baseline scenario. While 250 MW may be the *minimum requirement* that DESC's system operators need, it is far below the level of reserves that are *typically available* on DESC's system at most times based on historical operating practices. In essence, DESC's system has historically operated with a significant amount of excess operating reserves that are capable of absorbing higher levels of solar, without incurring any incremental costs.[6] Meanwhile, if the

[6] Note that this does not necessarily mean that DESC is operating its system inefficiently as there may be instances where the most efficient dispatch scenario also leads to excess operating reserves. However, if there are indeed excess reserves available under an efficient dispatch scenario, they should also be available for solar at no additional cost.

Guidehouse VIC analysis is configured such that the Baseline level of reserves available on DESC's system is closer to this minimum requirement of 250 MW, rather than what is typically available based on recent operating practices (i.e., >1,000 MW) then it would be an inaccurate representation of how DESC's system is operated.

Q. How do you recommend the Commission respond to this historical analysis?

A. I think the Commission should consider the possibility that incremental costs for DESC to integrate solar in the recent past and near future are close to zero, and that the VIC should similarly be set at $0/MWh. There may be incremental integration costs that should be contemplated under even higher penetrations of solar. However, a VIC Charge of any level for solar Tranches 1, 2, and 3 may be premature.

Q. Setting aside this historical perspective – that is, if we take DESC at its word that incremental integration costs are being incurred at this time and need to be quantified – does DESC's VIC modeling reflect a sound approach?

A. No. Even under the presumption that DESC will soon incur incremental integration costs that need to be quantified, there are still major deficiencies in DESC modeling approach that I will address in the next section.

6. DESC's 2021 VIC analysis suffers from many of the same deficiencies identified in the 2019 proceeding and introduces new errors. Correcting just three of these errors results in a 71% decrease in the VIC from present levels, rather than the proposed 88% increase.

Q. You referred to Order No. 2020-244 above, which found your testimony in that case "compelling" and adopted your recommended adjustments to the VIC since they "more closely reflects the actual cost of integration." Correct?

A. Yes.

Q. Can you summarize the deficiencies in DESC's 2019 analysis that your recommended adjustments addressed (and which the Commission's Order in that case ultimately adopted)?

A. Yes. Pertinent deficiencies I identified in 2019 included the following:

1) Islanded System: The DESC system was inaccurately modeled as an islanded system with very limited transfer capability between it and neighboring systems.
2) Volatility Profile: The modeled solar output profile overestimated volatility and only partially accounts for the effects of geographic diversity, thus inherently overestimating integration costs.
3) 4-Hour Forecast: The study's use of a relatively long 4-hour ahead forecast window overestimated integration costs by artificially restricting unit commitment and dispatch decisions.
4) Reserve Requirements during Non-Solar Hours: The analysis applies the additional reserve requirements to all 8760 hours of the year – including non-solar hours when there should be no additional reserves needed.
5) Intra-hour dispatch improvements: The model did not consider potential or likely future improvements in intra-hour dispatch practices, such as a regionally coordinated market for imbalance services (e.g., via the Southeast Energy Exchange Market ("SEEM")).

Q. Were there other deficiencies identified by other parties in the 2019 case?

A. Yes. In particular, ORS testified that DESC's approach led to an "excessive amount of additional reserve requirements to mitigate the Company's risk."[7] This was due to the fact that DESC's assumed operating reserves would be required to cover the *maximum* potential solar output drop, rather than a more reasonable risk level. According to ORS, even a minor adjustment from the maximum drop reduced the VIC by over 36%.

In addition, the PSC's consultant, Power Advisory, identified the following deficiencies:

- Inappropriate choice of data to analyze solar intermittency
- Lack of support for the risk threshold used to determine additional reserve requirements

[7] Docket No. 2019-184-E, Direct Testimoy of Brian Horii, p 13

- Inappropriate modeling of the additional reserve requirements
- Inadequate consideration of alternative sources of reserve capacity.

Furthermore, SELC identified the fact that the Fairfield Pumped Storage facility was modeled incorrectly.

Q. Has DESC updated its VIC methodology in the present 2021 case to address the deficiencies you and others previously identified?

A. DESC has made some minor improvements in its methodology that address two of the deficiencies I discussed above. However, the remaining deficiencies were left unaddressed or cannot be fully evaluated based on the information DESC has provided to date.

Q. What improvements did DESC make from its 2019 approach?

A. First, DESC reduced the assumed confidence interval for potential reserve shortfalls from the maximum potential solar output drop to a more reasonable level, consistent with ORS' 2019 recommendations. In the present case, it appears that DESC has assumed additional reserve requirements equal to a more balanced 90th percentile of instances with a drop in solar generation, rather than the extreme 100th percentile they assumed in 2019.[8]

Second, when calculating the incremental integration costs from the Guidehouse model runs, DESC excluded incremental costs during hours of day where there was no solar production. This is consistent with one of my recommendations in the 2019 case as described above (see item #4).

Q. Are there any major deficiencies identified above from 2019 that you have been unable to fully evaluate in the current 2021 proceeding?

A. Yes. As of this filing, I have not been able to fully determine whether DESC's assumed solar volatility profile and related reserve requirements have been corrected (see item #2 above). This is because DESC's workpapers provided to date do not contain critical information on how the incremental reserve requirements were determined based on the solar volatility profiles. While DESC did provide CCEBA with the four VIC-related workpapers listed below, none of these

[8] Exh. PBD-2, p 19.

contain information that specifically shows the formulas DESC used to calculate the incremental operating reserve requirements from the solar profiles contained within them.

VIC Workpapers provided to CCEBA:

- Guidehouse Flexibility Reserves Requirement Workbook 340-973 MW 6.7.21
- Guidehouse Flexibility Reserves Requirement Workbook 974-1073 MW 6.7.21
- Guidehouse VIC Calculation Workbook 974-1073 MW 06.07.21
- Guidehouse VIC Calculation Workbook 341-973 MW 06.07.21

Through discovery, DESC claimed that it did not retain some additional workpapers used to perform these critical calculations on incremental operating reserve requirements.[9] However, DESC's discovery responses did provide some limited information (including some workpapers) that reveal major discrepancies between how DESC calculated incremental operating reserve needs based on solar output as compared to what is realistic. This has cast significant doubt in my mind on the soundness DESC's underlying methodology.

Q. Can you elaborate on some the discrepancies between DESC's VIC modeling assumptions and realistic operating practices?

A. Yes. There are many discrepancies, but I will highlight three important ones. All three of these discrepancies include arbitrary and incorrect assumptions that inflate the modeled integration costs.

First, as I mentioned previously, DESC's standard operating practice is to carry additional operating reserves "in the amount of 40% of the hourly solar forecast or 40% of actual solar generation,"[10] which may already be overly conservative to begin with. However, in the VIC analysis, DESC inexplicably assumes that incremental reserves equal to 60% of solar generation are needed to avoid a reserve shortfall.[11] In DESC's workpaper provided in response to CCEBA Discovery Request 2-14, correcting this factor to 40% appears to eliminate all reserve shortfalls

[9] See for example, DESC's response to CCEBA Request 2-2.
[10] DESC response to ORS Request 3-3
[11] DESC response to CCEBA Interrogatory 2-17.

attributable to solar. This confirms the notion that there are essentially no incremental integration costs if the analysis properly reflected DESC's normal operating practices and thus the VIC should be set to $0/MWh.

Second, DESC made the arbitrary decision to restrict the operations of the Fairfield pumped hydro facility by defining specific hours in which it could pump or generate.[12] This facility is ideal for providing the reserves needed to accommodate solar, and could likely cover most, if not all, of any reserve shortfall being modeled under many circumstances. The decision to restrict this asset from its full capability does not reflect what I would expect DESC's system operators to do in the event of a reserve shortfall and undoubtedly inflates the instances of shortfalls in the baseline scenario. Table 13 in PDB-2 provides a clear illustration of this inaccuracy since the contribution of Fairfield to reserves is noted as "zero" despite the fact that this resource is not generating at the times listed and can also switch to generation mode in less than 15 minutes. If the full 576 MW generating capability of this unit were allowed, it would likely eliminate the <100 MW reserve shortfall in each of the examples provided.

Third, despite its claims to the contrary, it appears that DESC did not properly account for geographic diversity of solar resources on its system. For example, in the attachments to its response to CCEBA Discovery Request 2-14, DESC calculates the risk of solar shortfall. However, in this calculation, DESC incorrectly applies the assumed shortfall risk factor (i.e., 60% of solar generation) to the sum of *all* the solar generators on DESC's system. Thus, DESC is incorrectly assuming that a 60% drop in solar production could occur simultaneously across all facilities, which is statistically a virtual impossibility. In reality, any unexpected drop in a single facility is not likely to be correlated with other facilities.

Q. Are you concerned that DESC's calculation of the incremental operating reserve requirement may be inaccurate due to these discrepancies or due to other factors?

A. Yes. As detailed above in Section 4, DESC's modeling appears to include a highly inflated level of incremental operating reserves relative to what I would expect based on DESC's actual operating practices. This is true even though DESC opted to use the more reasonable 90th percentile

[12] DESC response to CCEBA Interrogatory 2-6

for solar drops. Thus, I believe these factors as well as others are leading to an inaccurate and inflated determination of incremental operating reserves.

Q. Were there any other errors introduced in DESC's 2021 VIC analysis that you were able to identify in the four VIC workpapers you listed above?

A. Yes. There are at least two new errors that I am aware of in the workpapers provided in the Supplemental Response to ORS 1-4. The first new error relates to how the modeled integration costs should be weighted based on the hourly solar generation profile. It appears that DESC may have intended at some point to include such a weighting, but ultimately did not do so in its calculation of the VIC charge. As Mr. David states in his testimony on the VIC calculation:

> "Impacts to production costs driven by increases to Operating Reserve requirements during non-solar hours are excluded from this analysis and impacts during hours in which solar generation is high are weighted more heavily than impacts during hours in which solar generation is low."[13] (emphasis added)

In reviewing the VIC Workpapers, it appears that DESC/Guidehouse did appropriately exclude the integration costs during non-solar hours. However, the calculations in the VIC Workpapers does not include any additional weighting of integration costs tied to the level of hourly solar generation as Mr. David's testimony suggests.[14]

Q. Has DESC subsequently confirmed that it did not weight integration costs based on solar production?

A. Yes. In its response to ORS Request 3-1 DESC stated that "all hours with solar generation were weighted the same."

Q. Has DESC attempted to rationalize its choice to weight all solar generation hours equally?

A. Yes. In ORS 3-1b, DESC tried to explain why an equal weighting was appropriate. However, I found DESC's explanation to be highly illogical. For example, DESC explained that a higher level

[13] P. David Direct, p 23.
[14] The workpapers do contain an item labeled "Solar-weighted Wholesale Energy Cost" but this is wholly unrelated to the calculation of the VIC charge.

of reserves than necessary may need to be ramped up in the morning in preparation for solar generation later in the day. Even if this were true it is not sufficient to explain an equal weighting during all morning hours. Moreover, this principle would not apply in the afternoon or evening since there is no need for incremental reserves to be held after sunset. Additionally, DESC claimed that the solar forecast error may be higher during morning/evening hours when evaluated on a percentage basis. However, the percent error is completely irrelevant to the total MW of reserves needed to accommodate any shortfall – what matters is the MW magnitude, duration, and unexpectedness of the shortfall. As such, DESC's rationale for an equal weighting of reserve needs across solar hours in its VIC analysis should be rejected.

Q. Can you explain why a proper weighting is important?

A. Yes. A proper weighting is necessary to account for the fact that the total MW at risk from a drop in solar output is not equal throughout the day, or throughout the year. DESC would not be required to carry the same level of incremental operating reserves in the early morning or late afternoon when solar production is low as it might in the middle of the day when solar generation is high. Applying an appropriate weighting to the modeled integration costs can help ensure that incremental costs are not excessively inflated during times of expected low solar production.

Ideally, the level of incremental reserves could be varied with solar production in the production cost model. However, as Guidehouse has stated, the PROMOD model is incapable of varying the level of operating reserves within a month.[15] However, while not ideal, the modeled integration costs can still be weighted to the correct level of solar production in a post-modeling step. This is the exact approach that Guidehouse used for excluding non-solar hours. Unfortunately Guidehouse did not extend this approach to include a similar weighting step for solar hours in its VIC calculation. As such the resulting VIC is excessively inflated.

Q. What is the second new error introduced DESC's 2021 VIC analysis?

A. The second error relates to how DESC allocates the modeled integration costs to different generators within the 973 MW solar buildout scenario. For this scenario, DESC's model evaluates the incremental cost of Operating Reserves necessary to support the full 973 MW of solar.

[15] It is worth noting that there are many commercially available production cost models besides PROMOD that have the capability of varying operating reserves on an hourly basis. In theory, DESC could have used one of these other models but it apparently chose not to.

However, 100% of these incremental costs are then assigned solely to the portion of the 973 MW included in Tranche 1, which represents the buildout from 341 to 973 MW (a 633 MW addition). Presumably at least some of the incremental integration costs in the 973 MW scenario are attributable to the initial 340 MW of solar generation included in the Baseline tranche. However, DESC unfairly assigned 100% of the costs associated with the 340 MW of Baseline facilities to the 633 MW of Tranche 1 facilities. This violates the principle of cost causation.

In order to ensure the VIC is fairly applied to Tranche 1 facilities, and to uphold the principle of cost causation, the VIC calculation for the 973 MW scenario should initially assume that integration costs are spread equally across all solar facilities.

Q. Are there any mathematical calculation errors you identified in any of DESC's workpapers?

A. Yes. In DESC response to CCEBA Discovery Request 2-14, there are formula errors for years 2029-2031 in calculating the MW of Reserve Shortfall. The formulas lead to a highly inflated, and incorrect reserve shortfall in these years. Specifically, the reserve shortfall in these years is calculated as the total reserves online *minus* the reserves required (i.e., for solar, contingency and regulation) whereas it should be the reverse of this (i.e., required reserves minus total reserves online), which is how the calculation is performed in earlier years.

Q. In the Guidehouse VIC analysis, do the assumed MW values for the incremental operating reserve requirements (e.g. Exh. PBD-2, Table 1) seem logical to you based on the MW shortfalls identified by the Guidehouse model (i.e. from the model run without incremental reserves)?

A. No. As shown in Exh. PBD-2, Figure 13, the Guidehouse simulation run without incremental operating reserves led to potential shortfalls during solar hours, especially in the afternoon. However, DESC's response to CCEBA Interrogatory 2-18 shows that the actual MW shortfalls identified by Guidehouse in this model run are far less than the incremental reserve requirements that Guidehouse subsequently applied. In fact, the highest level of shortfall in the scenario without

incremental reserves was 151 MW (for October). This is approximately half of the 299 MW in assumed incremental reserve needs Guidehouse assumed for Tranche 1 in that month. Thus, Guidehouse's assumed incremental operating reserve requirements are not only inflated relative to DESC's actual operating history, but they are also inflated relative to what Guidehouse's own modeling suggests. It is therefore still unclear to me how DESC determined the incremental reserve requirements presented in Exh. PBD-2 Table 1 since the assumed requirements appear to be roughly double what they should be based on the Guidehouse-modeled shortfalls.

Q. Can you provide a summary of the deficiencies in DESC's VIC calculation methodology which have been corrected in its 2021 proposal and those which have not?

A. Yes. The table below compares the approach taken by DESC in 2019 to its current (2021) approach for each of the deficiencies/errors identified above and identifies whether they have been corrected or not.

#	Deficiencies/Errors	2019 Approach	2021 Approach	Corrected?
1	Islanded System Operations	Assumes external resources unable to provide reserves	Assumes external resources unable to provide reserves	No
2	Solar Volatility Profile and calculation of incremental Operating Reserves	Overestimated; no full accounting of geographic diversity	Overestimated; no full accounting of geographic diversity; 60% (vs. 40%) reserves assumed; etc.	No
3	Solar Forecast Time Horizon	4-hour Forecast (too long)	4-hour Forecast (too long)	No
4	Reserve Requirements during Non-Solar Hours	Yes	Non-solar hours excluded via post-model adjustment	Yes
5	Intra-hour Dispatch Improvements (e.g., via a regional imbalance market)	None considered	None considered	No
6	Risk Tolerance/ Confidence Interval	100th percentile (extreme)	90th percentile (more balanced)	Yes

7	Model Parameters for Fairfield PSH Facility	Incorrect	Incorrect (pumping/generating schedule arbitrarily limited)	No
8	Weighting of Integration Costs to Solar Output	No weighting	No weighting	No
9	Allocation of 973 MW scenario integration costs	N/A	100% of costs allocated to Tranche 1	No

Q. Do you have any specific observations about the other remaining deficiencies identified above?

A. Yes. While there are many unresolved issues, I'm particularly concerned about DESC's continued assumption that a 4-hour solar forecast is appropriate for the VIC analysis for a variety of reasons. First, this appears to be inconsistent with the actual approach that DESC's system operators use on a regular basis. As described in DESC's response to ORS 3-3, the Company's system operators hold "operating reserves in the amount of 40% of the hourly solar forecast" (emphasis added). This implies that the Company actually uses a 1-hour solar forecast, rather than a 4-hour forecast. Second, there is substantial evidence that a 1-hour forecast would significantly reduce the level of solar forecast error relative to a 4-hour forecast. For example, a recent analysis published by NREL shows that the use of a 1-hour forecast reduces forecast error by over 40% depending on the forecasting technique being used.[16] A 1-hour forecast is superior to a 4-hour forecast since it is closer in time to real-time operations. Thus, it reflects more accurate information about the meteorological conditions that dictate solar output, and there is less chance for a significant error (e.g. due to cloud movement) relative to a 4-hour forecast. Third, it appears that the sole reason Guidehouse used a 4-hour forecast in its modeling is the fact that this is the only publicly available forecast data available. Meanwhile, there are a variety of commercial vendors that offer forecasting services on a more real-time basis than 4-hours.[17] The fact that DESC uses hourly solar forecasts suggest that they may already implement such a solution and could have representative 1-hour forecast data available for the VIC analysis. In fact, DESC was readily able to identify vendors that provide forecasts of a shorter time horizon.[18] However, it appears that

[16] https://www.nrel.gov/docs/fy18osti/70030.pdf
[17] For example, see the following: Virtual Power Plant | Wind and Solar Power Forecasts (energymeteo.com)
[18] See DESC response to CCEBA Interrogatory 2-2.

DESC chose not to take this more accurate approach and instead rely upon the same outdated 4-hour forecast data it was criticized for using in 2019.

7. <u>As in 2019, DESC continues to avoid a transparent methodology informed by stakeholder feedback for determining its integration costs</u>

Q. Did DESC solicit any stakeholder feedback or peer review in conducting its integration study?

A. Not to my knowledge.

Q. Does the law in South Carolina offer any guidance on how such a stakeholder review process might occur?

A. Yes. Upon passage of Act 62, South Carolina statute was amended to include the following language authorizing the Commission and ORS to conduct an independent study on integration services:

> "Section 58 37 60. (A) The commission and the Office of Regulatory Staff are authorized to initiate an independent study to evaluate the integration of renewable energy and emerging energy technologies into the electric grid for the public interest. An integration study conducted pursuant to this section shall evaluate what is required for electrical utilities to integrate increased levels of renewable energy and emerging energy technologies while maintaining economic, reliable, and safe operation of the electricity grid in a manner consistent with the public interest. Studies shall be based on the balancing areas of each electrical utility. The commission shall provide an opportunity for interested parties to provide input on the appropriate scope of the study and also to provide comments on a draft report before it is finalized. All data and information relied on by the independent consultant in preparation of the draft study shall be made available to interested parties, subject to appropriate confidentiality protections, during the public comment period. The results of the independent study shall be reported to the General Assembly."

I believe the process laid out in this statute is sound and would provide a much more transparent and independent approach to determining the true integration needs and related costs for South Carolina utilities. In contrast, the integration study performed by DESC in this proceeding did not include "an opportunity for interested parties to provide input on the appropriate scope of the study" nor did it provide for "comments on a draft report before it is finalized." Thus, rather than rely solely on a study commissioned by DESC with no peer review or input from outside stakeholders in this proceeding, I believe the process defined by Act 62 better serves the public interest and would be more appropriate for investigating what the magnitude of such a charge should be. Going forward, I recommend that a Technical Review Committee be established by the Commission to oversee future integration costs studies in future avoided cost proceedings.

8. <u>Based on the historical analysis in Section 5, a VIC of $0/MWh is appropriate. However if a non-zero VIC is adopted in this proceeding, it should be corrected to account for at least some of the deficiencies in DESC's analysis.</u>

Q. What do you recommend the Commission do regarding DESC's proposal to increase the VIC charge for facilities in both Tranche 1 and Tranche 2 and above (i.e. generation capacity beyond 974 MW)?

A. Given the many errors and deficiencies in DESC's analysis, I believe that DESC has presented insufficient evidence to justify an increase to the VIC for facilities in either Tranche 1 or Tranche 2 (and above). As such I think DESC's proposed VIC rates should be rejected as discriminatory against QFs.

However, I'm also cognizant that continuation of an interim VIC rate that could still be "trued up" at a future date presents commercially unreasonable uncertainty for current or future QFs with a VIC clause included within a PPA. This continued uncertainty in the VIC can present an unnecessary burden for QFs when seeking project financing which could also be considered discriminatory. As such, I recommend that the Commission approve a final VIC charge for facilities in Tranche 1 and Tranche 2 (and above) that is fixed and not subject to further adjustments. This approach would not limit this Commission from further updating the VIC in the

future on a going forward basis, but it would provide commercial certainty for operating QFs and any future QFs that execute a PPA prior to the Commission revisiting this issue in a future proceeding.

Q. What approach do you recommend for determining a final VIC charge for Tranches 1 and 2?

A. Since DESC's historical operations have consistently included enough operating reserves to integrate solar Tranches 1, 2, and 3, there appears to be virtually no incremental integration cost for the foreseeable future. Additionally, correcting errors in DESC's workpapers appears to eliminate any projected reserve shortfall attributable to solar.[19] As such, I recommend the Commission approve a VIC of $0/MWh. However, to the extent this Commission feels compelled to approve a non-zero VIC, then I would recommend setting that charge at a level that uses DESC's VIC analysis as a starting point, but corrects for as many of DESC's errors as possible.

Q. How could some of DESC's errors be corrected?

A. As I explained above, DESC's VIC calculation includes several new errors, in addition to the ongoing deficiencies identified in 2019. Specifically, two of these new errors relate to the incorrect weighting for solar production, and the incorrect allocation of integration costs to Tranche 1. At a minimum, these two new errors should be corrected. Additionally, I believe another adjustment should be made to account for faulty assumptions regarding the forecast time horizon (i.e., 4-hr versus 1-hr).

Q. Have you estimated the impact on the VIC for Tranche 1 facilities if these two new errors were corrected and the two additional adjustments are made?

A. Yes. I estimate that this would reduce the VIC for Tranche 1 facilities to $0.28/MWh (a 71% reduction from present levels).

Q. Can you describe the steps you took to make corrections for the errors relating to a) the misallocation of Baseline integration costs and b) the incorrect weighting?

A. Yes.

[19] For example, as I mentioned above this can be done by using the correct 40% level of reserve requirement for solar instead of the inflated 60% level used by DESC in its attachment to CCEBA Request 2-14.

I will first address the correction I made for DESC's misallocation of the Baseline solar integration costs. To make this correction, I used the following workpaper provided by DESC as a starting point: "Guidehouse VIC Calculation Workbook 341-973 MW 06.07.21." This workpaper contains information on how DESC computed the VIC charge from the PROMOD model results of its 973 MW scenario. In the workpaper, total system production costs are reported at an hourly level for both the "with reserves" and "without reserves" cases. In each case, annual sums are determined from the hourly values during solar producing hours only. The difference in annual cost (in $) between the "with reserves" and "without reserves" cases is then divided by Tranche 1 solar production (in MWh) to find the integration cost (in $/MWh) for each year. I changed one variable in the formula of this final calculation step to correct for the misallocation of the Baseline solar integration costs. Specifically, I replaced the Tranche 1 solar production MWhs in the formula with the Total solar production MWhs (which includes both Tranche 1 and the Baseline resources).

To address the incorrect weighting, I simply extended the approach already used by DESC which I described above. More specifically, DESC gave a weighting of 0% to the hours when solar is not producing by summing 0% of the production costs from these hours. DESC also gave a weighting of 100% to all solar hours by summing 100% of the production costs from these hours. To provide the correct weighting, I simply adjusted the amount summed from each hourly cost value to a level between 0-100% that corresponds to the actual solar output during that hour. Each hour's weighting was set equal to the ratio of the solar output during that hour relative to the maximum output during all hours. This appropriately discounts the modeled integration costs to reflect the hourly level of solar production relative to the maximum level possible (which is what DESC effectively assumes by weighting all solar hours equally). Correcting just these two errors results in a VIC of $0.47/MWh, which is a 51% decrease in the VIC from the present interim level.

Q. Can you describe the additional adjustment you made to the non-zero VIC calculation to account for the incorrect forecasting time horizon?

A. Yes. If a non-zero VIC is approved, I recommend that it be adjusted to account for the fact that DESC's system operators appear to use a 1-hour solar forecast rather than a 4-hour forecast which was assumed in the Guidehouse analysis. As I previously explained, the use of a 1-hour forecast can reduce the solar forecast error on the order of 40%. As such, I recommend the VIC be reduced proportionally which, in conjunction

with the other corrections, results in a VIC of $0.28/MWh (i.e., an 71% decrease from the present interim VIC).

Q. Does this correct for all of the deficiencies you have identified in DESC's analysis?

A. No, it does not. In fact, I think it is likely that the "correct" level of the VIC is even lower than $0.28/MWh and is likely to be close to zero. However, given DESC's approach in both this case and the 2019 proceeding, a transparent and independent analysis, with stakeholder input, appears to be necessary to identify the correct VIC. Absent that independent analysis and stakeholder process, I believe that setting a final and fixed VIC in the $0/MWh to $0.28/MWh range represents an acceptable approach which is much more reasonable than what DESC has proposed. This would also provide much needed certainty for Tranche 1 facilities. Thus, if the Commission feels compelled to approve a non-zero VIC, I believe that a final Tranche 1 VIC of $0.28/MWh or less could be adopted as a compromise solution.

Q. If the VIC were reduced to the $0/MWh to 0.28/MWh range for Tranche 1 facilities, what would this mean in terms of the true up outlined by the Commission in Order No. 2020-244?

A. Based on my analysis, $0/MWh to $0.28/MWh is more reflective of the true integration costs Tranche 1 facilities are incurring rather than the $0.96/MWh VIC charge that has been in effect since mid-2019. As such, if the VIC were revised to a lower level, the existing Tranche 1 facilities should be entitled to a refund for DESC's overcollection of integration costs from the current VIC. The refund should be based on the difference between the VIC charges paid to date, and the charges that would have been paid if the VIC rate had been at or below $0.28/MWh. For a non-zero VIC, this is likely a conservative estimate of the appropriate refund since it does not account for several of the remaining deficiencies in the VIC calculation I have identified above.

Q. What do you recommend as the final VIC for Tranche 2 and above?

A. I recommend that the VIC for Tranche 2 and above be corrected for the same weighting error that I described for Tranche 1. Using the same approach, this would initially reduce the VIC from DESC's proposed level of $3.43/MWh to $1.19/MWh. Additionally, I recommend that the

Tranche 2 VIC be further adjusted to account for the fact that DESC's system operators appear to use a 1-hour solar forecast rather than a 4-hour forecast which was assumed in the Guidehouse analysis. As I previously explained, the use of a 1-hour forecast can reduce the solar forecast error on the order of 40%. As such, I believe the Tranche 2 VIC can be further reduced to $0.71/MWh. If a non-zero VIC is used for Tranche 2, I recommend that it be set at or below this level. As with the Tranche 1 VIC charge, I may revise this assessment as I am able to review and analyze additional workpapers and data responses.

9. DESC's mitigation protocol is highly flawed and appears designed to ensure the maximum VIC is charged rather than encourage behaviors that would actually mitigate integration costs.

Q. Did DESC's application in this case include proposed Mitigation Protocols that would allow QFs to reduce the VIC charge under certain circumstances?

A. Yes. DESC has included in its Amended Application materials a proposed mitigation protocol document that describes a process through which a QF may avoid paying some or all integration charges in each month.[20] Although DESC did not provide direct testimony justifying its Mitigation Protocols, the document provided describes the basic mechanics of the proposal.[21]

Q. Even though DESC did not offer testimony justifying the proposed mitigation protocol, can you summarize the key provisions to the best of your ability?

A. Yes. According to the proposed protocols, a "solar site variability metric" ("SSVM") would be calculated for every 5-minute interval for each solar QF. The SSVM equals the percent change in energy production for each 5-minute interval relative to energy production in the 5-minute interval one hour prior. In other words, the SSVM represents the percentage increase or decrease in solar production from 1 hour ago. If the maximum SSVM during a month is 25% or less, the seller pays no integration charges that month. If it is greater than 25% but less than 45%, the facility pays half

[20] DESC Amended Application Exhibit 9 (Solar Site Variability Metric Mitigation Protocol)
[21] Witness Kassis states that Witness Bell "describes in greater detail" DESC's proposed Mitigation Protocols (Witness Kassis Direct Testimony at 39, line 16), but Witness Bell's Direct Testimony does not mention the Mitigation Protocols.

the full integration charges. If the SSVM exceeds 45%, the facility pays the full integration charge that month.

Q. Do you have any concerns about this proposed protocol?

A. Yes, I have several concerns. Specifically, I believe there are at least four major flaws in DESC's proposed SSVM calculation methodology, as well as other logistical concerns.

Q. Can you describe the four major flaws you've identified in DESC proposed protocol?

A. Yes.

First, the SSVM should compare a facility's output to forecasted or expected production, not to the prior hour's production. Incremental operating reserves are only needed to respond to *unexpected* changes in supply, not expected changes. If solar output is already expected to decline (e.g. due to the setting sun or predicted overcast conditions), then this is something that DESC's system operators would already have known and planned for and would not require additional integration costs. Unfortunately, DESC's proposal does not reflect this. For example, the SSVM calculation treats a decline in output around sunset the same way as it treats a decline during midday when the decline would be both less expected and more significant to system operations. If the hourly output was compared to a forecast (rather than the prior hour's production), the unexpected midday drop would appropriately lead to a higher SSVM than the predictable evening decline.

Second, the SSVM should capture hours with the greatest potential for a MW drop in energy production, rather than the greatest percentage drop. Under DESC's current proposal, the percentage-based approach overly weights morning and evenings hours when solar production is relatively low. During these times, minor fluctuations in MW output could lead to a high SSVM , even though the corresponding need for incremental operating reserves would be low. I have conducted an analysis showing that the morning and evening hours generally have higher SSVM percentages under DESC's proposed calculation methodology, even though they represent a very small risk for MW drops and therefore very small incremental integration costs. Rather than this skewed approach, DESC should modify its protocol to ensure that it accurately weights the potential for variability in absolute MW terms.

Third, DESC should use an average, not a maximum, SSVM to evaluate whether a facility can avoid integration charges. Using the single highest SSVM in a month is not representative of the facility's overall performance throughout a month. A facility with very low volatility and occasional deviations may not impact DESC's integration costs as much as a facility with frequent deviations from its forecasted output that are still less than the maximum. An average SSVM over the course of the month would more accurately reflect this cost causation.

Fourth, the SSVM metric should not necessarily be determined based on a single solar installation. Since DESC manages supply at the system level, any incremental integration costs are incurred based on system-wide solar production. As such, an unexpected drop in production at any one site may not be relevant if other sites are overproducing. Instead, the relevant metric should be an individual site's contribution to any fleet-wide drops in solar production.

Q. Based on these shortcomings, do you think DESC's proposed mitigation protocol is likely to provide a meaningful incentive for QFs to reduce their contribution to integration costs?

A. No I do not. Instead, I believe DESC has constructed a mitigation protocol whereby most QFs will not be able to meaningfully mitigate their VIC charge.

Q. Are there ways in which DESC could improve its mitigation protocols to both encourage lower integration costs and better reflect cost causation?

A. Yes. If the proposed SSVM method is used as a starting point, there are several modifications I would be willing to suggest in developing a more idealized mitigation protocol that is based on best practices. However, rather than rely upon this relatively flawed framework, I believe a better approach would be for DESC to use the mitigation protocol Dominion developed for North Carolina as a starting point for South Carolina. I have attached that document as Exhibit B.

Q. Does the North Carolina protocol address each of the flaws you identified above?

A. It addresses most of them. Specifically, this protocol: a) measures the change in output relative to an expected forecast, rather than the prior hour; b) measures hourly variability in terms of total MW rather than a skewed percentage-based method; and c) captures the totality of performance over time rather than singling out one hour each month.

Q. Are there any further improvements you would suggest to the North Carolina protocol that should be adopted in this case?

A. Yes. There are at least three discrete improvements I would suggest:

First, the hourly variance should only be recorded and summed for hours in which this value was negative indicating that output was less than forecast (i.e. a drop in solar production). If a QF happens to be overperforming, that should reduce DESC's overall operating reserve needs and therefore should not be counted towards the hours that need to be mitigated.

Second, the annual forecast provided by the QFs should be able to be modified on a more frequent basis. It is unrealistic to think that a generator would be able to forecast the precise weather conditions that might impact performance more than a few days in advance (let alone a year in advance). As such, more frequent updates (e.g. hourly, daily or weekly) are necessary for the protocol to be effective.

Third, since integration costs are managed by DESC on a system-wide basis, QF owners should be able to aggregate multiple sites when performing the mitigation calculation.

Q. Are there any other practical implementation issues that should be addressed regarding the mitigation protocol?

A. Yes. DESC calls for QFs to install a separate meter for the purpose of calculating the hourly variability. While I agree that a separate meter may be needed for the solar and storage components, I believe the normal production meter could be used in lieu of one of these. Second, the proposed two-day deadline for data submissions appears to be unduly onerous. Sellers should be allowed five business days after month-end to submit the SSVM spreadsheet to DESC. Finally, the two-strikes disqualification for non-submission of data is also unduly onerous. Sellers should not be disqualified from using the Protocols for the duration of their PPA based on failure to deliver the SSVM spreadsheet.

Q. Does this conclude your testimony?

A. Yes.